Institut für Reaktorwerkstoffe

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KERNFORSCHUNGSANLAGE JÜLICH

des Landes Nordrhein-Westfalen - e. V.

DISASSEMBLY AND SAMPLING OF GRAPHITE BALL FUEL ELEMENTS

von

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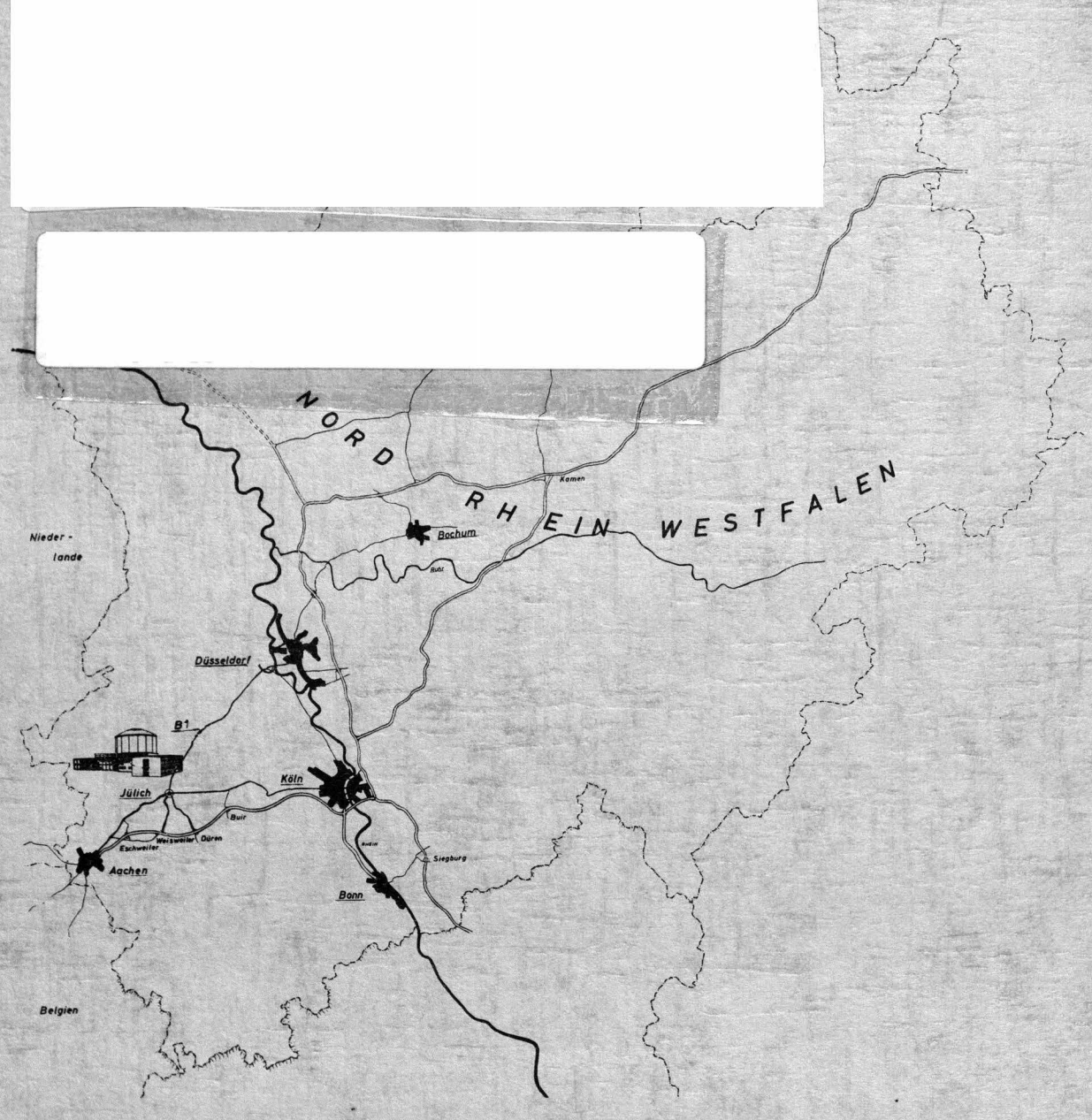

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DISASSEMBLY AND SAMPLING OF GRAPHITE BALL FUEL ELEMENTS

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The present report arose from the work performed in the scope of the THTR - association contract involving Euratom - Brown Boveri/Krupp Reaktorbau GmbH - Kernforschungsanlage Jülich des Landes Nordrhein-Westfalen e. V.

DISASSEMBLY AND SAMPLING OF GRAPHITE BALL FUEL ELEMENTS

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Abstract - Résumé

In the scope of the THTR postirradiation examination program, irradiated ball-type fuel elements must be examined and prepared for advanced experiments. This requires a controlled breaking-open of the graphite shell for taking samples of definite size and dimensions from the inner and outer parts of the fuel element.

In the present report are described two special pieces of equipment which have been developed and constructed for this purpose. They emphasize avoiding contamination of the neighbouring equipment of the box, and diminishing the inevitable cross-contamination of the surfaces of the samples themselves by means of a suitable ventilation procedure.

Dans le cadre du programme d' examen post-irradiatoire du projet THTR, des éléments de combustible, du type boulet, doivent ètre examinés et aussi préparés pour d' autre essais. Ceci requièrent un dédoupage controllé de la coquille de graphite; pour prélèvement d' échantillons de grandeur et de dimensions bien déterminées de l' intérieur et de l' extérieur de l' élément combustible.

Dans le présent rapport sont decrits deux pièces d' équipments dévelopés spécialement pour cet objectif.

Une ventilation spéciale permet d' éviter la contamination propre des échantillons par eux même.

A. Part of the fuel element development work performed by Kernforschungsanlage Jülich (KFA-Jülich) in support of the THTR-program is the post-irradiation examination of the various graphite ball fuel element types under consideration. These fuel elements will be irradiated both in test-reactors and in the AVR-reactor which is in an advanced stage of construction at the KFA Jülich, site.

These fuel elements consist of varying configurations of Th-UC_2 coated particles inclosed within a graphite shell of 6 cm outside diameter. This report discusses disassembly and sampling procedures used for the following three types:

1.) Hollow sphere - Fig. 1 (a)

2.) Homogeneous kernel - Fig. (b)

3.) Ring gap - Fig. 1 (c)

The irradiated fuel elements are brought to the hot cells either in loops or rigs from the Dido reactor, or in welded stainless steel cans from the AVR reactor. Each reactor uses a different transport cask.

The various containers are opened in the dismantling cell by means of a sabre saw or alternate devices.

After the balls have been removed, they are transferred to other cells to be prepared for metallographic, radiochemical, and physical examinations.

Their preparation involves both opening the ball to extract the coated particles and/or the kernel, and cutting and removing small samples from the various parts.

After the non-destructive examinations of the whole fuel element, are finished, such as weighing, measurement of dimensions, annealing test etc., the ball is cut apart. The kernel is removed and small samples of the shell, kernel, and individual coated particles are taken. The key equipment items for doing this are:

1.) Lathe machining device for ball fuel elements
2.) Graphite ball splitter

B. The lathe machining device is shown in Fig. 2, and has a dual purpose:

a.) to cut a circumferential "V" - groove in the ball to assist in splitting
b.) to core-drill samples from the outer graphite shell

The ball is grasped in a special machining device fastened between the head stock and tail stock in the bed of a small, table-sized, vertical lathe.

Power is transmitted during operation only by friction after the tail stock has been driven to the head stock by means of an electric motor.

During joining both parts of the lathe machining device, a hollow cylinder automatically is closed over the fuel element to avoid undesirable distribution of graphite dust in the box.

The graphite dust collected in the hollow cylinder is sucked off by a vacuum cleaner, thus largely avoiding dust contamination.

The machining operation consists of making three equatorial, 60°-"V"-grooves, 5mm deep in the surface of the ball.

The pattern is the same as one would use in slitting the skin of an orange in such a manner as to remove 8 equal segments of skin.

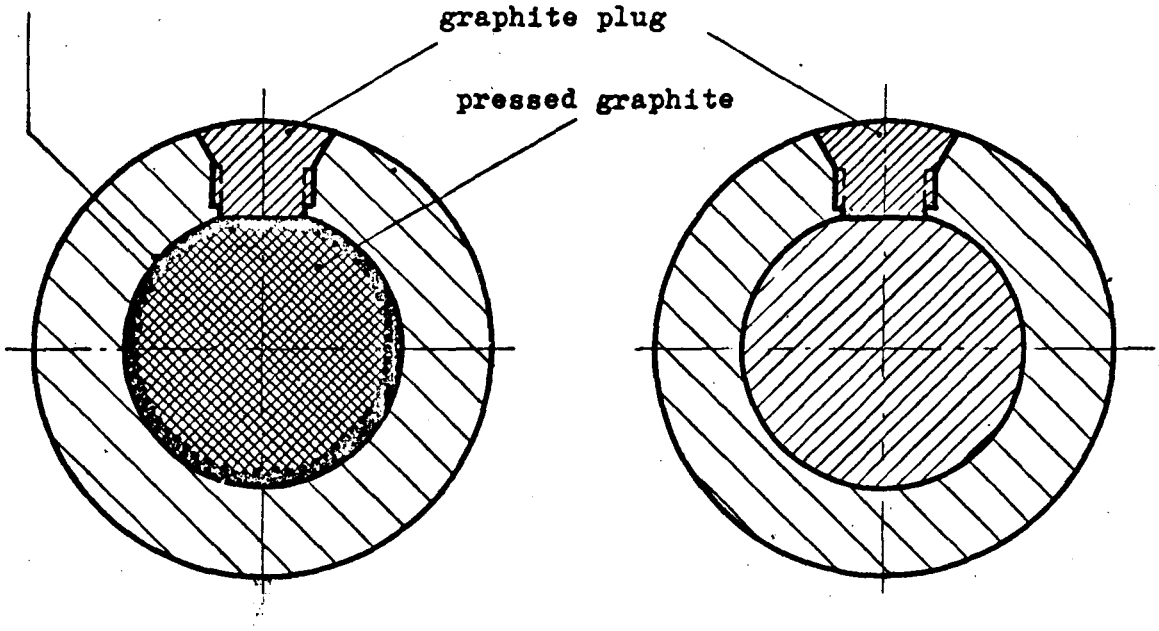
After cutting each V groove the position of the ball must be changed. Centre pins bring the ball in the right working position. Mainly for radiochemical examinations, cylindrical graphite samples must be drilled out of the shell of the ball. They are about 6 mm diameter and 12 - 15 mm long. In the design of the core-drill it was desired that the quantity of graphite dust be as small as possible. The ball is brought into the right position by means of three centre pins as described before. An air-flush is provided, as shown in Fig. 2, to avoid cross-contamination of the radiochemical samples as the core-drill is removed. This is done with compressed air which is blown through the hollow drill. The drilled-out cylindrical samples can easily be broken out of the shell by means of a simple tool as shown in picture ....

C. The "V"- grooved ball can then be taken to pieces by the ball splitter as follows:
the graphite ball is put on the lower blade by means of the manipulator, so that the blade edge is in the V-groove. The ball cannot fall over, and only one manipulator is needed for this entire process. Then the upper blade is driven down by means of an electric motor.
After the ball is split into roughly-equal pieces, the upper blade can be shifted so that the halves can be divided again. (see picture ...) Limit switches stop the working lift, and protection plates retain the pieces.

The quantity of dust generated by this process is very little, and a vacuum cleaner easily removes what residue there is.

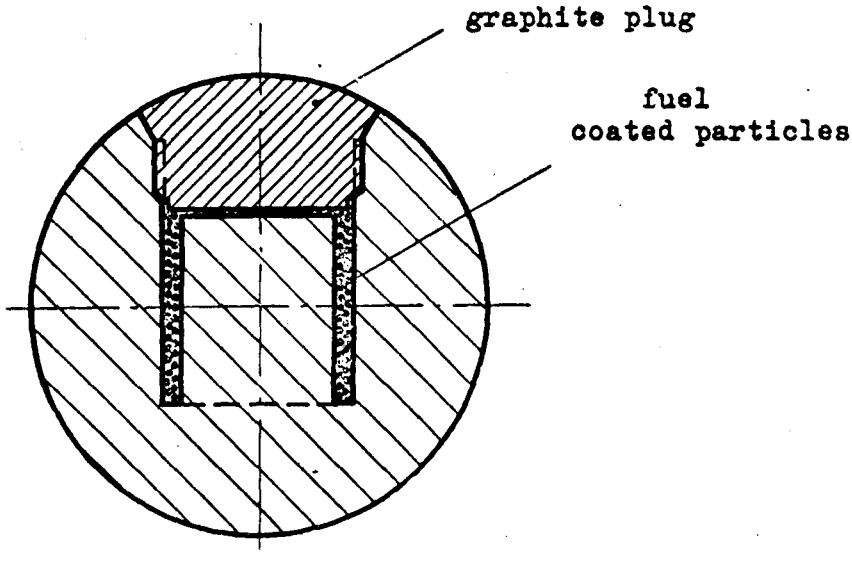
The segments can then be removed easily, and the coated particles freed either individually by a tweezer attachement for the slaves, or in clumps held together by matrix material.

fuel
(coated particles)



1 a hollow sphere element

1 b homogeneous kernel element



1 c ring gap element

Stückz.	Benennung	Abmessungen Halbzeug	Normblatt Nr.	Werkstoff	Lfd. Nr.	Teilzeichn. Nr. Bemerkungen	Modell Nr.

Freimaßtoleranzen		Tag	Name	DIFFERENT TYPES OF TEST FUEL ELEMENTS	Maßstab
	Bearb.	12.10.64	M. Ullrich		
	Gepr.				
	Norm.				

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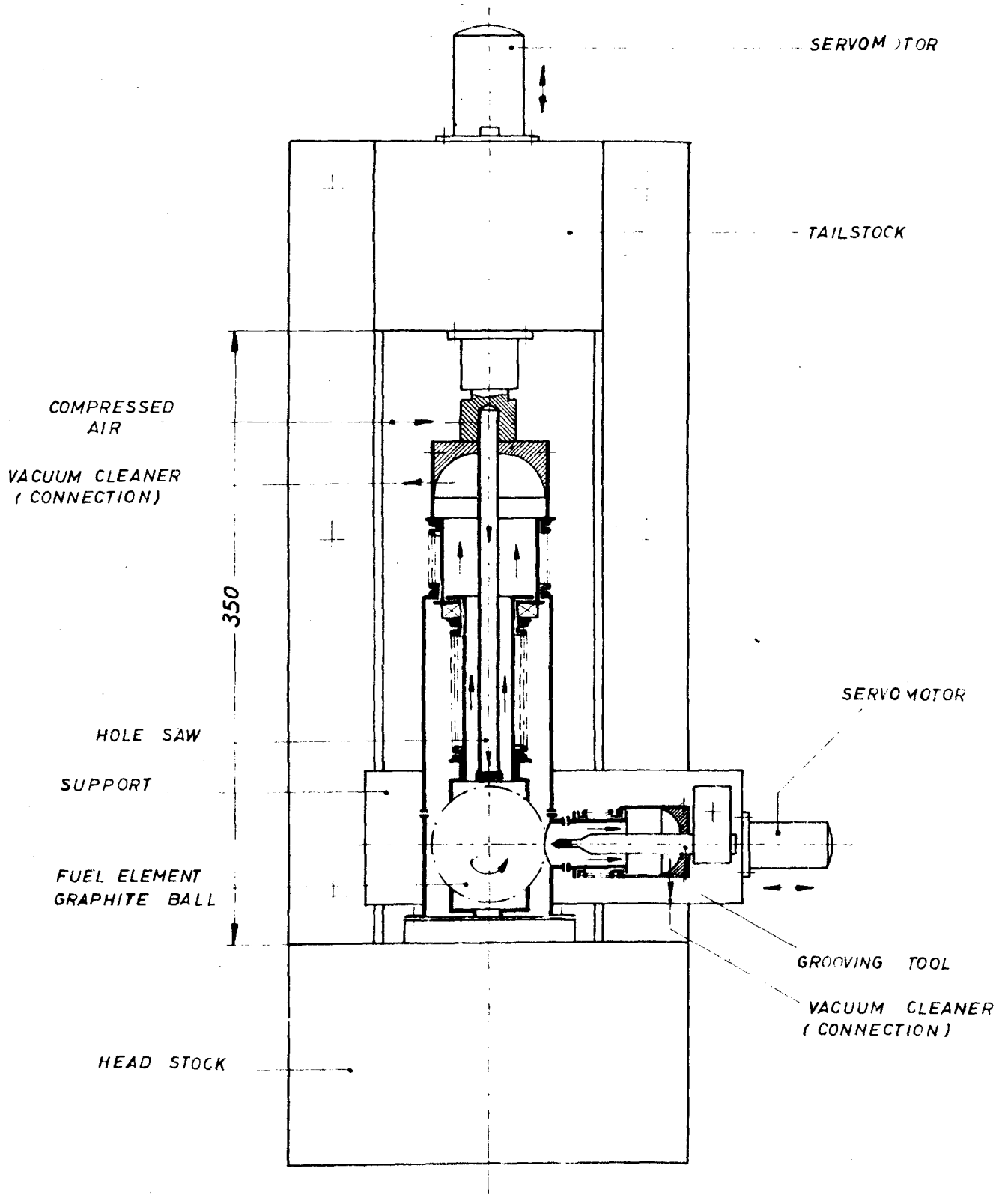
1



Stückz.	Benennung	Abmessungen Halbzeug	Normblatt Nr	Werkstoff	Lfd Nr	Teilzeichn. Nr / Bemerkungen	Modell Nr

Freimaßtoleranzen		Tag	Name	LATHE-MACHINING-DEVICE FOR BALL FUEL ELEMENTS	Maßstab
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	Gepr				
	Norm				

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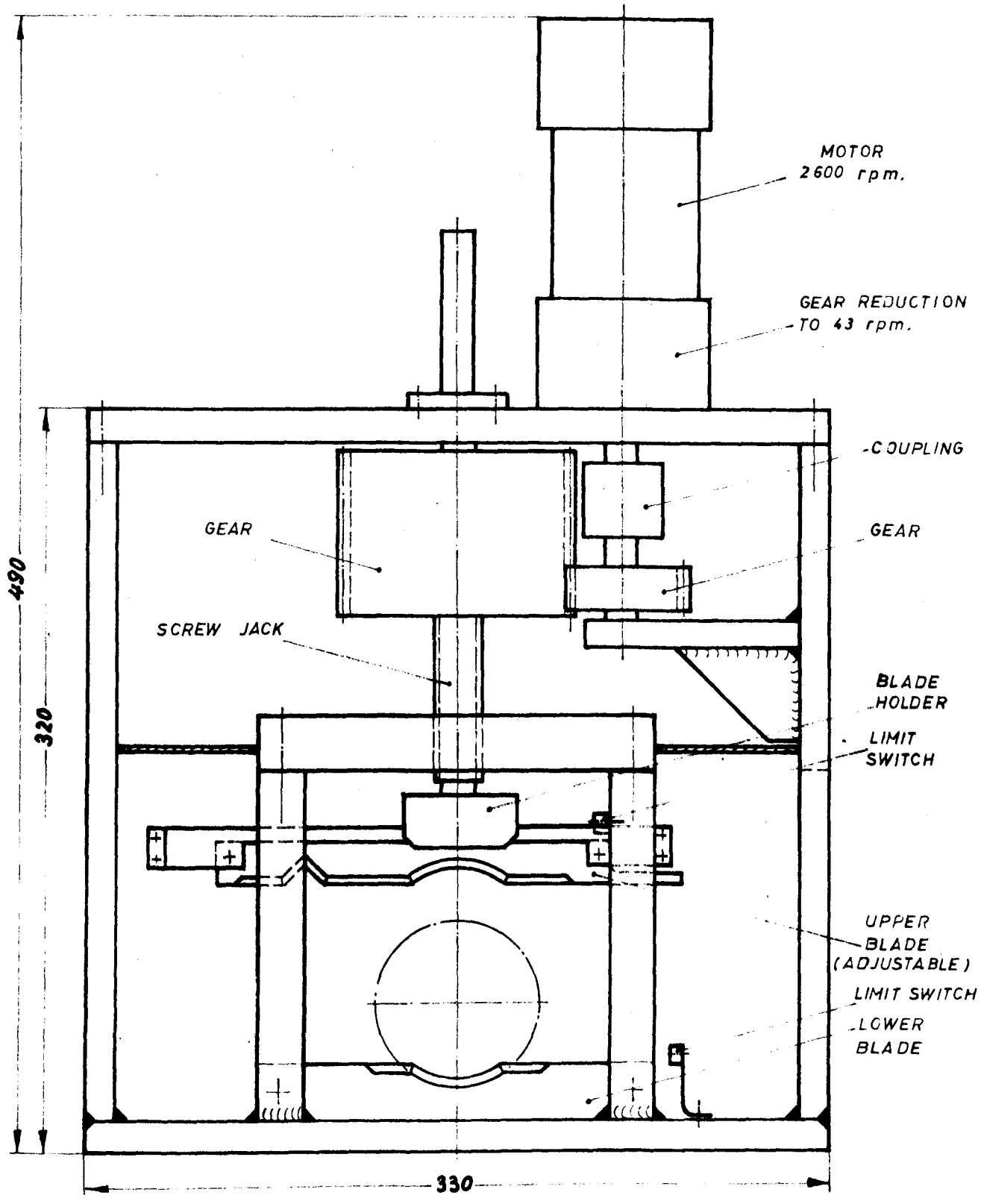

Stückz	Benennung	Abmessungen Halbzeug	Normblatt Nr	Werkstoff	Lfd Nr	Teilzeichn Nr / Bemerkungen	Modell Nr

Freimaßtoleranzen		Tag	Name		Maßstab
	Bearb	9.5.64	H. Erfurth	GRAPHITE - BALL - SPLITTER	
	Gepr				
	Norm				

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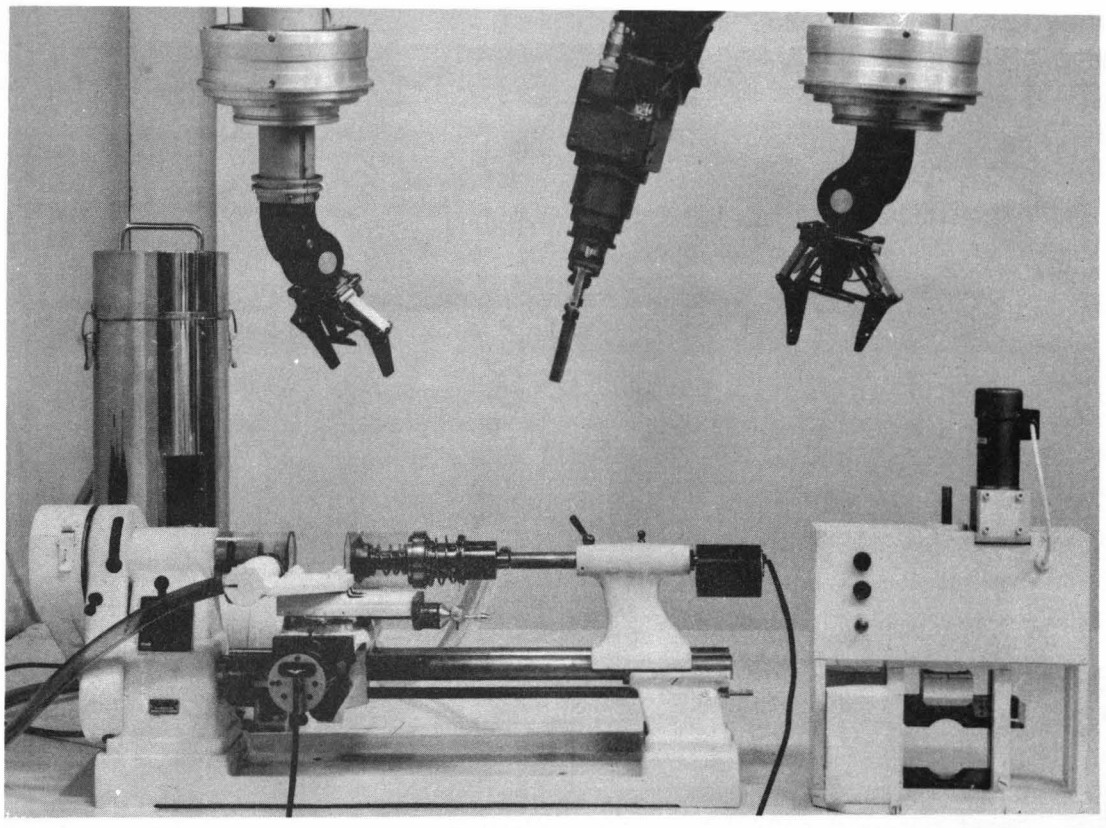
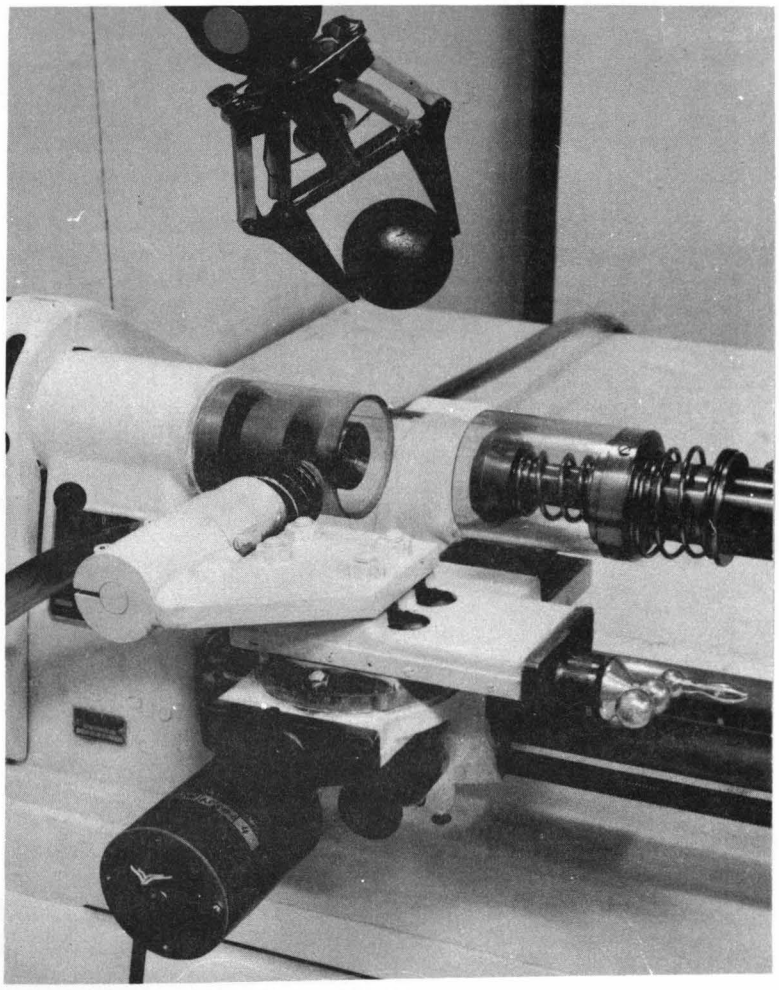
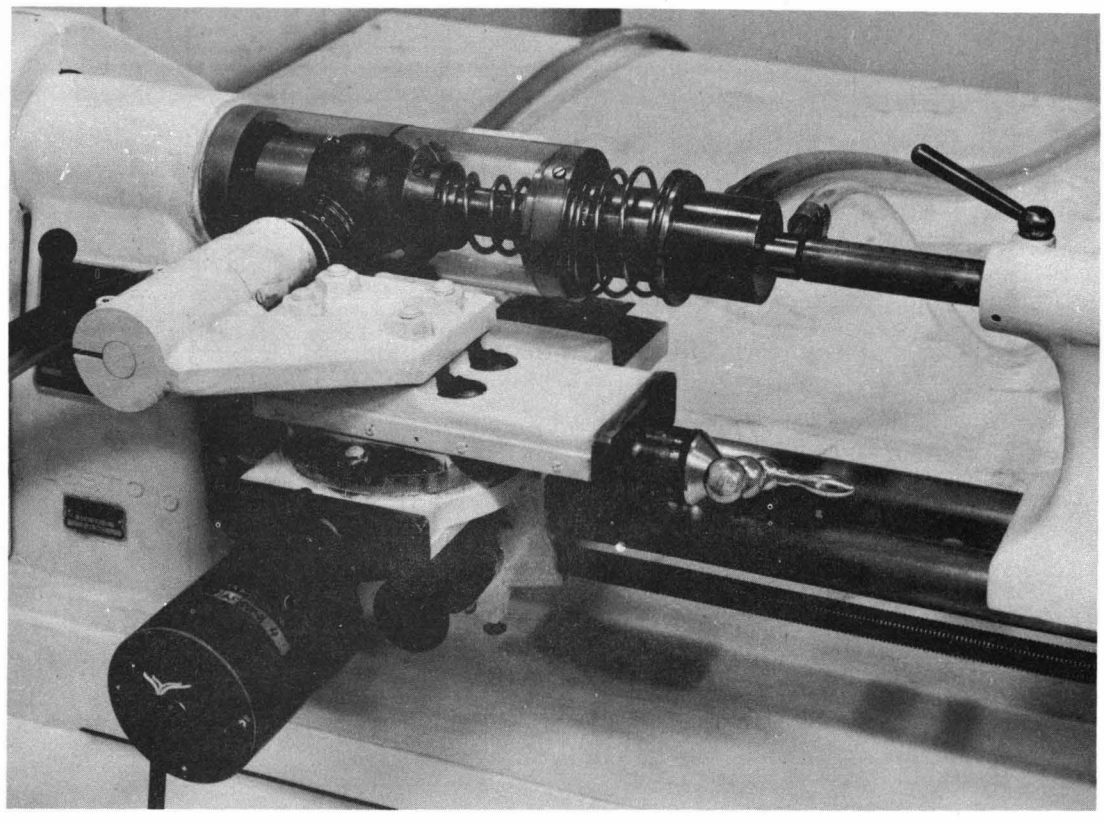
3



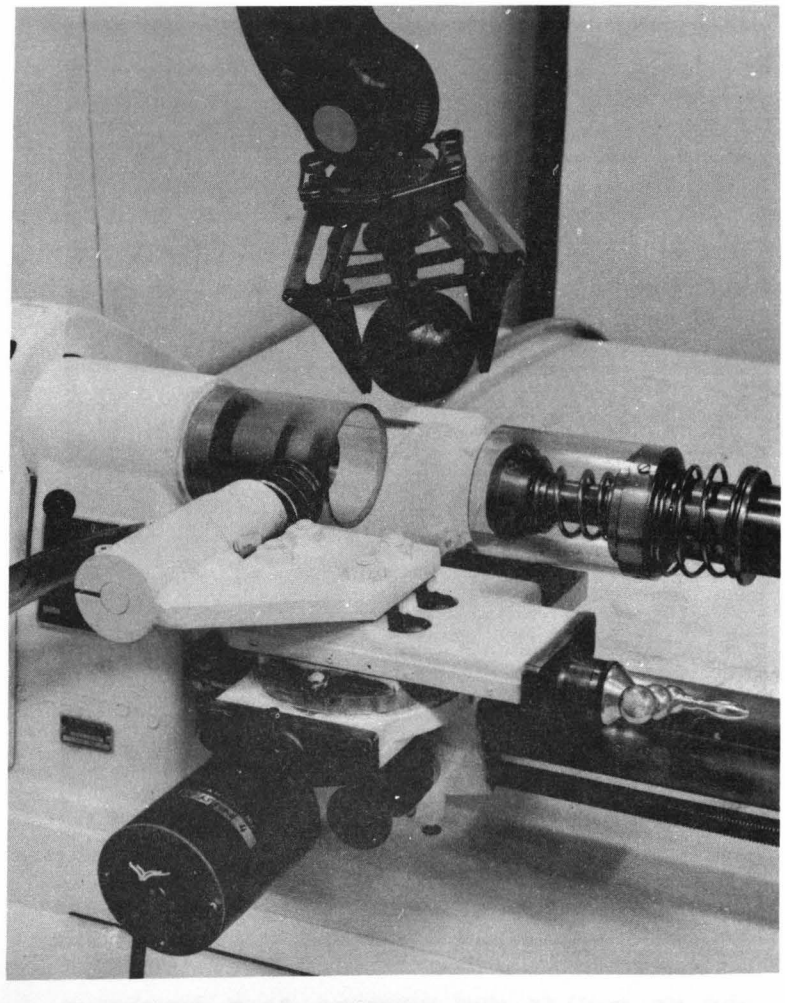
LEFT: LATHE-MACHINING-DEVICE
RIGHT: GRAPHITE-BALL-SPLITTER



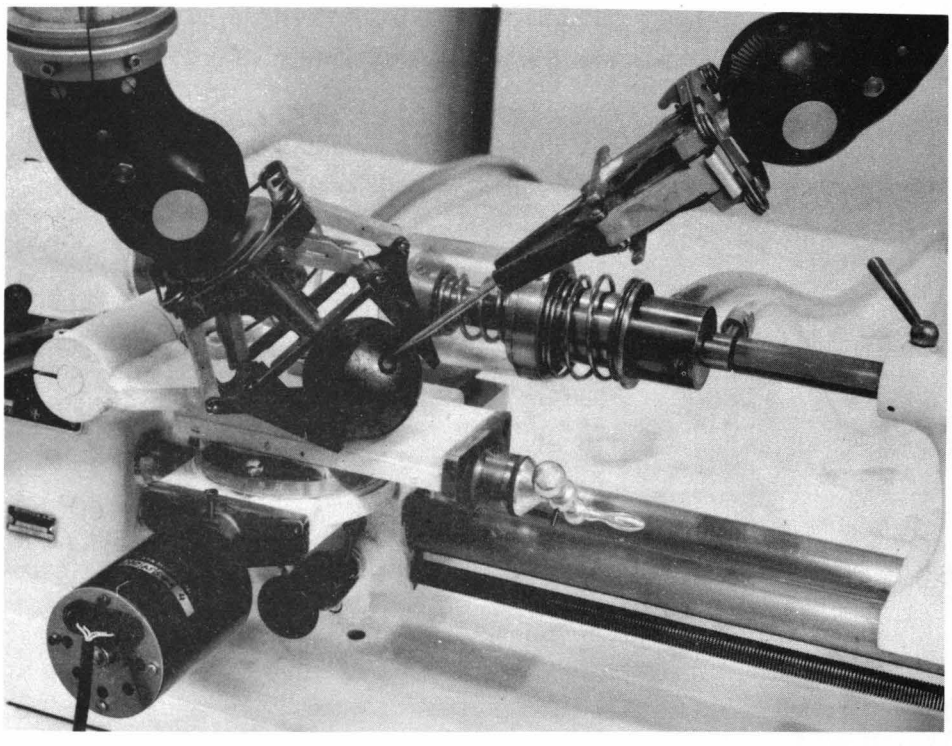
BALL IS PUT IN



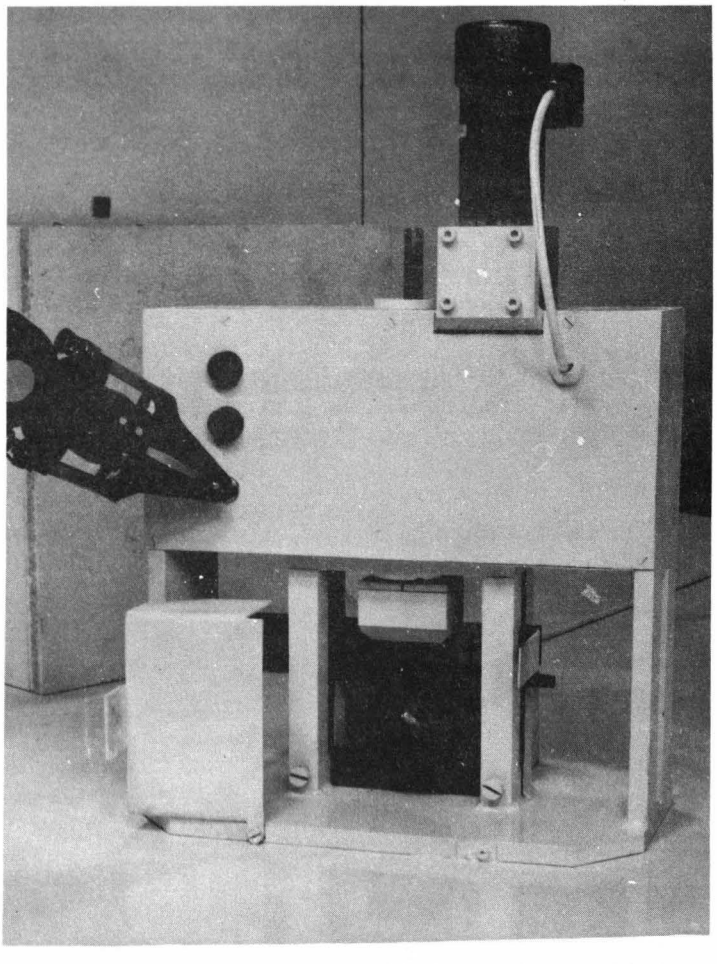
BALL HELD IN THE MACHINING-DEVICE



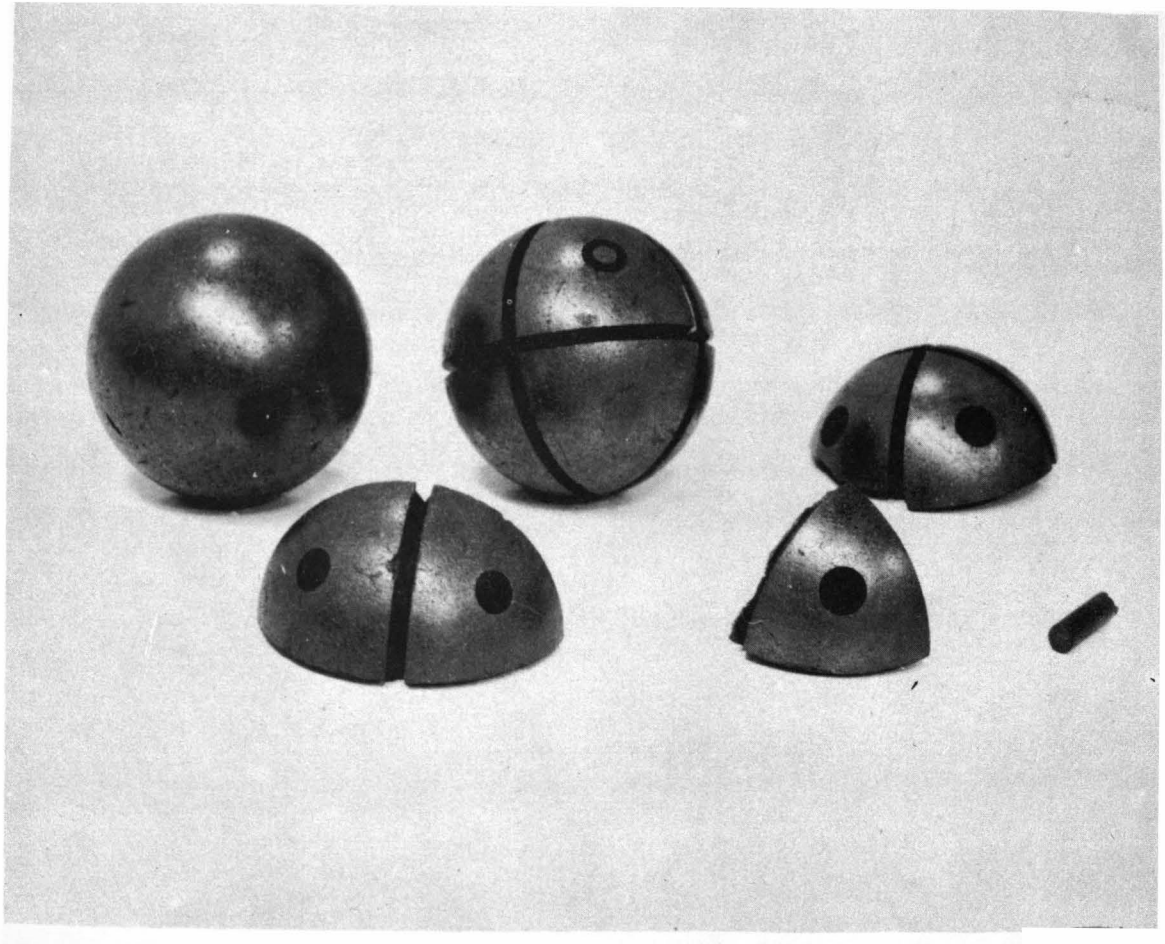
BALL AFTER BEING MACHINED



BREAKING OUT A CYLINDRICAL SAMPLE BY
MEANS OF TWEEZERS



MACHINED BALL BETWEEN THE BLADES OF THE
GRAPHITE-BALL-SPLITTER



DIFFERENT PARTS OF A SPLITTED BALL